

WHAT IS CLAIMED IS:

1 1. A system for liquefaction monitoring of a gas characterized by an operating temperature
2 and an operating pressure in a gas piping system, comprising:
3 means for providing at least two parameters of said gas;
4 means for providing at least one reference data sets of said gas, said at least one reference
5 data sets containing data pairs of temperatures and pressures;
6 means for determining a liquefaction status of said gas based on said two parameters and
7 said at least one reference data set; and
8 means for reporting said liquefaction status.

1 2. The system of claim 1, wherein one of said at least two parameters is correlated to said
2 operating temperature and another one of said at least two parameters is correlated to said
3 operating pressure of said gas.

1 3. The system of claim 1, wherein said means for providing at least two parameters
2 comprises at least one sensor selected from the group consisting of a temperature sensor and a
3 pressure sensor.

1 4. The system of claim 1, wherein said at least two parameters are said operating
2 temperature and said operating pressure of said gas measured respectively by a temperature
3 sensor and a pressure sensor.

1 5. The system of claim 1, wherein said at least one reference data sets contains data pairs of
2 temperatures and corresponding saturated vapor pressures of said gas.

1 6. The system of claim 1, wherein said at least one reference data sets consists of three
2 reference data sets, said three reference data sets giving rise respectively to three liquefaction
3 tolerance levels, and one of said three reference data sets contains saturated data for said gas
4 product.

1 7. The system of claim 6, wherein said means for determining said liquefaction status is a
2 tolerance-level-determination engine that compares at least one of said operating temperature and
3 said operating pressure of said gas with at least one of said three liquefaction tolerance levels to
4 determine said liquefaction status.

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1 8. The system of claim 7, wherein said means for reporting said liquefaction status of said
2 gas is a results-reporting engine that reports said liquefaction status, and further calculates and
3 reports at least one of a pressure liquefaction margin and a temperature liquefaction margin for
4 said gas.

1 9. A system for liquefaction monitoring of a gas product in a gas piping system, comprising:
2 at least one sensor selected from the group consisting of temperature and pressure sensors
3 for monitoring said gas product;
4 a tolerance-level-determination engine adapted for determining a liquefaction status of
5 said gas product using data from said at least one sensor; and
6 a results-reporting engine operatively connected to said tolerance-level-determination
7 engine for reporting said liquefaction status.

1 10. The system of claim 9, wherein said tolerance-level-determination engine is adapted to
2 receive two input parameters that are correlated respectively with an operating temperature and
3 an operating pressure of said gas product; one of said two input parameters being provided by
4 said at least one sensor; and said liquefaction status is determined by comparing data derived
5 from said two input parameters and said one or more reference data sets comprising saturated
6 temperature and vapor data for said product gas.

1 11. The system of claim 10, further comprising a compensation circuit selected from the
2 group of a temperature compensation circuit and a pressure compensation circuit.

1 12. The system of claim 9, wherein said system is connected to said gas piping system by a
 2 connection selected from the group consisting of a dead-ended connection and a flow-through
 3 connection.

1 13. The system of claim 9, wherein said tolerance-level-determination engine comprises at
 2 least one of means for phase determination, means for data comparison and means for data
 3 storage.

1 14. The system of claim 9, wherein said results-reporting engine comprises at least one of
 2 means for pressure liquefaction margin determination and means for temperature liquefaction
 3 margin determination.

1 15. The system of claim 9, wherein said at least one sensor and said engines are enclosed
 2 within a single housing.

1 16. A system for use on a gas piping system having a pressure transducer comprising:
 2 a tolerance-level-determination engine operatively connected to said pressure transducer,
 3 and adapted to determine a liquefaction status of a gas in said gas piping system;
 4 a temperature data collector connected to said tolerance-level-determination engine;
 5 a results-reporting engine operatively connected to said tolerance-level-determination
 6 engine;
 7 at least one indicator operatively connected to said results-reporting engine and adapted
 8 to indicate a liquefaction status of a gas product.

1 17. The system of claim 16 further comprising a housing for holding said tolerance-level-
 2 determination engine and said results-reporting engine, said housing being adapted to mount onto
 3 said gas piping system proximate to said pressure transducer.

1 18. A system for use on a gas piping system containing a gas product, said system
 2 comprising:

3 sensors adapted to monitor a pressure and a temperature of said gas product;
4 a tolerance-level-determination engine adapted for liquefaction monitoring using data
5 from said temperature and pressure sensors;
6 a results reporting-engine operatively connected to said tolerance-level-determination
7 engine;
8 a housing enclosing said tolerance-level-determination engine and said results reporting
9 engine;
10 said housing being removably connected to said gas piping system; and
11 at least one indicator connected to said results-reporting engine.

1 19. The system of claim 18 wherein said tolerance-level-determination engine includes
2 means for adapting tolerance-levels to different gas products.

1 20. The system of claim 18 wherein said housing is selectively movable along said gas-
2 piping system.

1 21. The system of claim 18 wherein:
2 said housing, sensors and results-reporting engine form a unit;
3 said system including a plurality of units operatively positioned along said gas piping
4 system, a communications network having a monitoring station, said monitoring station
5 including means for monitoring said units.

1 22. A method for determining liquefaction of a gas product in a gas piping system using a
2 data collector, said method comprising the steps of:
3 gathering data from said gas product selected from the group consisting of pressure and
4 temperature data; and
5 determining a liquefaction status from said gathered data.

1 23. The method of claim 22 further comprising the step of indicating said liquefaction
2 tolerance level.

1 24. The method of claim 23 wherein said indicating step includes one of delivering said
2 indication remotely from said gas piping system and delivering said indication at a location
3 proximate to said gas piping system.

1 25. The method of claim 22 wherein said determining step includes providing information
2 corresponding to saturated properties of said gas product.

1 26. The method of claim 25 wherein said determining step further includes comparing said
2 gathered data to saturated property information.

1 27. A method for liquefaction monitoring of a gas in a piping system, comprising:
2 providing at least two parameters of said gas, said at least two parameters being
3 correlated respectively to an operating pressure and an operating temperature of said gas;
4 providing at least one reference data set for said gas, said at least one reference data set
5 containing data pairs of temperatures and pressures;
6 determining a liquefaction status of said gas based on a comparison of said at least two
7 parameters and said at least one reference data set; and
8 reporting said liquefaction status for said gas.